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# Central Eurasia

## AVIATION & COSMONAUTICS

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[The following are translations of selected articles in the Russian-language monthly journal AVIATSIYA I KOSMONAVTIKA published in Moscow. Refer to the table of contents for a listing of any articles not translated.]

## Soviet Version of U.S. Raid on Supung GES in Korean War

*92UM0063A Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 5, May 91 (signed to press 10 Jun 91) pp 16-17*

[Article by Hero of the Soviet Union Lieutenant-General of Aviation (Retired) G. Lobov under the rubric "The 'Blank Spots' of History": "In the Skies of North Korea"; conclusion—for prior installments see Nos. 10-12 for 1990 and Nos. 1-4 for 1991]

[Text]

**Strike Against the Supung Hydroelectric Power Plant—Truth and Conjecture**

A striving for objectivity in the portrayal and evaluation of events in the two-year period of the war in Korea forces that the reader's attention be directed to another combat episode, around which disputes have continued up to the present day. The discussion concerns the massive air raid by American aircraft against the hydroelectric power plant [GES] at Supung, located on the Yalu River.

Analysis of the results of the strike occupies quite a large place in works by American authors devoted to combat air operations in Korea. They compare it with the largest air operations of World War II. Aircraft from the 5th Tactical Air Army, the Navy and the Marine Corps—a total of about 500 planes—took part in it simultaneously, according to data presented in those publications.

An editorial in the American journal QUARTERLY REVIEW noted that this raid "proved the effectiveness of the planning, coordination and interaction of our Air Forces units in the Far East." It really should be acknowledged that the overall operation was well planned and executed from a purely military viewpoint. Much better for the U.S. Air Force, in any case, than the tragic "Black Tuesday." At least one gross error, however, was made in the planning at the time and in the course of executing this strike, which could have doomed the Americans to a major defeat had the MiGs sortied to repel the raid.

We will not analyze in detail the American plan for the raid, since it does not directly concern the MiG-15s, which did not come up to repel the strike. I feel it necessary at the same time, however, to elaborate on the aforementioned error in order to refute the laudatory statements of the QUARTERLY REVIEW.

The journal reported that the start of the attack was preceded by operations to suppress the air-defense artillery... **while the fighter-bombers of the Air Force and Navy were waiting to turn onto the target bomb-run heading in altitude-stacked formations** (my emphasis—*G.L.*). The presence of the strike groups in close proximity was envisaged instead of their approach to the target at a set time.

One can clearly imagine what fate would have awaited those aircraft, which were unable to perform even simple defensive maneuvers with full bomb loads, in the event of an attack on them by our MiGs. Of course, the more than 100 F-86s assigned to protect the strike aircraft would have tried to intercept the MiG-15s before they reached the fighter-bombers. They were, however, not capable of performing that mission. The 64th Fighter Air Wing and the OVA, meanwhile, had considerably more aircraft at the Andong Air Center than the 208 indicated by the Americans. A lesser portion of them would of course have been assigned to engage the F-86s in the event of a sortie, while the main forces would have been able to inflict heavy losses on the fighter-bombers and, probably, prevent the mass strike against the target or reduce its consequences to a minimum.

So then, the chief question remains why we, with considerable fighter forces at our disposal, did not send them up to repel the enemy attack. The Americans felt that the MiGs did not come up to intercept for two reasons: either the Soviet pilots were frightened by the numerical superiority of the enemy, or they were ordered to protect only Chinese industrial cities and airfields. The journal says that the American pilots observed that as many as 208 MiGs located at the airfields around Andong took off and headed in the direction of Manchuria, not one of them attacking the American air armada, leaving the Korean targets undefended.

Analysis of the weather conditions provides an answer to this question. A powerful storm front with low cloud cover and heavy rain had completely closed our alternate airfields in Manchuria by 1600 hours on 23 Jun 52 (the strike against the Supung GES was carried out starting at 1601), was moving fast and was located directly at the Andong airfield. Our aircraft, had they gone up, had no chance of landing safely. All of the fighters of the 64th Fighter Air Wing and the OVA that took off to intercept the enemy would in all likelihood have been lost.

In this situation the commander of the 64th and the commanding general of the OVA made the difficult but sole correct solution—the MiGs would not go up to repel the mass air strike. I would note that the information regarding the fighters taking off and heading for Manchuria is simply contrived, since not a single aircraft took off from the Andong airfield. There was no other way out in this situation. Even had we been able to break off the enemy attack and defeat it at the price of the loss of the principal forces of the fighter air corps and the OVA, it would have been at a too-great and unwarranted cost. The enemy would in that case have obtained complete freedom of action over the whole territory of the KNDR [Korean People's Democratic Republic] for a prolonged period, and could have destroyed important targets at any moment without encountering opposition in the air.

The correctness of this decision had to be proved at the highest level. That was far from a simple matter when

one takes into account specific features of the nature of the leaders of the USSR and the PRC at the time...

Many questions have remained as yet unanswered despite the antiquity of the events nonetheless. Why, for example, did the Americans make no attacks on the major electric-power plants of the KNDR over the almost two years of war? Or why did the enemy not blow up the Supung GES as early as 1950, when he fled the area in a panic under the onslaught of the Chinese troops?

There are questions for our side as well. Why, for example, was only one Chinese 20-piece regiment of 76mm guns assigned for the air defense of the Supung GES? The commander of the 64th Fighter Air Wing could not have reinforced the air defense of the Supung GES, since the missions of the larger air units and their stationing were determined by the high command. The corps commander had the opportunity of using only one battalion of air-defense artillery. After the strike against the Supung GES, on the other hand, one of the available large air-defense units was brought up at once to cover the rebuilding work on orders from above.

I do not know the higher political or military aims that would explain such actions. One may suppose, however, that there was a certain logic in this—a reluctance by the opposing sides to broaden the scope of a regional war.

The combat operations continued nonetheless. I was permitted to return to the Motherland in November of 1952, after almost two years of participation in the war. I was invited to Peking before my departure. Marshal Chu De reported at a meeting with the leaders of the PRC that Mao Zedong was ill, and asked that heartfelt gratitude and best wishes be extended to all of the Soviet pilots in the name of the Chinese people.

I was awarded a special certificate signed by Mao Zedong at a reception given in honor of the Soviet fliers. I assume that the lofty assessment and warm words on my modest contributions to the fulfillment of our internationalist duty expressed in it can by all rights pertain as well to all the Soviet pilots who made a large contribution to victory over the aggressor, the creation and improvement in combat of the Chinese and Korean Air Forces and the reinforcement of friendship between our peoples.

**Fliers Awarded the Title of Hero of the Soviet Union for Internationalist Aid to the Korean People in War of Patriotic Liberation of 1950-1953 %**

| No. and name | Year of birth | Date of decree | Military rank and position* | Combat sorties | Aircraft shot down |
|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 |
| 1. Stepan Antonovich Bakhayev | 1922 | 13 Nov 51 | Major, deputy squadron commander | 166 | 11 |
| 2. Arkadiy Sergeyevich Boytsov | 1923 | 14 Jul 53 | Captain, deputy squadron commander for political affairs | ** | — |
| 3. Nikolay Grigoryevich Dokashenko | 1921 | 22 Oct 51 | Captain, flight commander | 148 | 11 |
| 4. Grigoriy Ivanovich Ges | 1916 | 10 Oct 51 | Captain, squadron commander | about 120 | 9 |
| 5. Anatoliy Mikhaylovich Karelin | 1922 | 14 Jul 53 | Major, deputy regimental commander | about 50 | 5 |
| 6. Sergey Makarovich Kramarenko | 1923 | 10 Oct 51 | Captain, deputy squadron commander | 149 | 13 |
| 7. Georgiy Ageyevich Lobov | 1915 | 10 Oct 51 | Major-general aviation, commander of 64th Fighter Air Wing | 15*** | 4 |
| 8. Mikhail Ivanovich Mikhin | 1923 | 14 Jul 53 | Captain, deputy squadron commander | — | — |
| 9. Stepan Ivanovich Naumenko | 1920 | 14 Jul 53 | Major, deputy squadron commander | — | — |
| 10. Boris Aleksandrovich Obraztsov | 1923 | 10 Oct 51 | Senior lieutenant, pilot | — | — |
| 11. Dmitriy Pavlovich Oskin | 1919 | 13 Nov 51 | Major, regimental commander | 150 | 14 (1) |

**Fliers Awarded the Title of Hero of the Soviet Union for Internationalist Aid to the Korean People in War of Patriotic Liberation of 1950-1953 % (Continued)**

| No. and name | Year of birth | Date of decree | Military rank and position* | Combat sorties | Aircraft shot down |
|---|---|---|---|---|---|
| 12. Grigoriy Ulyanovich Okhay | 1917 | 13 Nov 51 | Captain, assistant regimental commander | 122 | 11 |
| 13. Yevgeniy Georgiyevich Pepelyayev | 1918 | 22 Apr 52 | Colonel, regimental commander | 108 | 20 |
| 14. Mikhail Sergeyevich Ponomarev | 1920 | 13 Nov 51 | Captain, squadron commander | 140 | 14 |
| 15. Grigoriy Ivanovich Pulov | 1918 | 22 Apr 52 | Lieutenant colonel, regimental commander | 120 | 8 |
| 16. Dmitriy Aleksandrovich Samoylov | 1922 | 13 Nov 51 | Senior lieutenant, pilot | 161 | 10 |
| 17. Aleksandr Pavlovich Smorchkov | 1919 | 13 Nov 51 | Lieutenant colonel, deputy regimental commander | 191 | 15 |
| 18. Yevgeniy Mikhaylovich Stelmakh | 1923 | 10 Oct 51 | Senior lieutenant, senior pilot | 15 | 1 |
| 19. Serafim Pavlovich Subbotin | 1923 | 10 Oct 51 | Captain, regimental navigator | — | — |
| 20. Nikolay Vasilyevich Sutyagin | 1923 | 10 Oct 51 | Captain, deputy squadron commander | about 150 | 21 |
| 21. Fedor Akimovich Shebanov | 1921 | 10 Oct 51 | Senior lieutenant, pilot | about 150 | 6 |
| 22. Lev Kirillovich Shchukin | 1923 | 13 Nov 51 | Captain, flight commander | 212 | 15 |

* Military rank and position given at time of awarding of title of Hero of the Soviet Union.—** No precise data as yet.—*** The title of Hero of the Soviet Union was awarded to General G. Lobov with regard for his services in the Great Patriotic War (346 combat sorties, 19 aircraft shot down personally and eight as part of a group).—*Information prepared by Colonel (Retired) G. Plotnikov, leader of the Korean Group of the International Commission of Internationalist Soldiers of the Soviet War Veterans Committee.*



## Design and Development History of Su-24 Tactical Bomber

*92UM0063B Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 5, May 91 (signed to press 10 Jun 91) pp 20-23*

[Article by Deputy Chief Designer L. Loginov and NIO [Scientific-Research Department] Chief V. Yakovlev under the rubric "Soviet Aviation Technology": "The Su-24 Close-Support Tactical Bomber"]

[Text] *The time has come when it is possible to reveal one of the shining pages in the history of the Sukhoy OKB [Experimental Design Bureau]—to evaluate the Su-24 aircraft and the titanic labors that went into its creation.*

In the 1960s, when anti-aircraft defense had reached a high level due to the appearance of effective means of detection and destruction, a simple increase in altitude and speed could not now ensure the invulnerability of bombers. It could also not be achieved through low-altitude flights at comparatively low speeds. Increased speeds close to the ground made piloting the aircraft virtually impossible with the control systems that existed at the time. The concept of overcoming air defenses at the lowest possible altitudes with terrain following at maximum flight speeds in good and bad weather conditions was nonetheless chosen by specialists after careful analysis. The assignment to develop a close-support tactical bomber, able to fly that way and replace the Il-28 and Yak-28B, was issued to the Experimental Design Bureau imeni P. Sukhoy.

The new aircraft, combining the properties of a ground-attack aircraft and tactical bomber, was to make flights at both supersonic and subsonic speeds, conduct combat operations under good and bad weather conditions, day and night and at all altitudes, and defeat ground and naval surface targets with aimed delivery in manual and automatic control modes. The performance of missions to block the movements of a ground enemy and destroy roads, bridges, tunnels, operating radar stations, air-defense command-and-control posts, SAM launchers,

aircraft at airfields, artillery, military-industrial facilities, railroad trains and other radar-contrasting targets in operations principally at low altitudes was planned for it, as opposed to aircraft for the direct support of troops on the battlefield.

It was also entrusted with the detection and destruction of transport, communications, forward artillery spotting and other aircraft and helicopters, day and night, using air-to-air missiles with heat-seeking homing heads in good weather and using cannons with visual sighting in the daytime, as well as the performance of incidental photo reconnaissance. The possibility of employing the aircraft from dirt runways—as well as hard-surfaced ones—of limited dimensions in order to function under such conditions and be rapidly redeployed was envisaged to allow for the fact that an enemy, especially in the initial phase of combat operations, would try to disable permanent airfields.

The Su-24 was at first not very similar to what we see today, both outwardly and in design. It was created as a vertical-takeoff aircraft with both lifting and cruising engines and a fixed delta wing. One aircraft, which received the designation T6-1, was even built but never saw the light of day, since many difficulties were discovered in the design engineering of the airframe and the power plant and the resolution of aerodynamic issues.

The concept of short takeoff and landing was thus selected instead of vertical—which also proved not to be very easy to realize, as did high-speed flight at low and very low altitudes. Flights at such altitudes and speeds with conventional aircraft configuration are accompanied by alternating loads on the wings and by discomfort; according to pilots who have encountered such phenomena, the feeling is like being dragged along a washboard.

The designers who set to work in 1967 under the leadership of P. Sukhoy and his closest assistant, Ye. Felsner, designated chief designer, were able to solve these problems using a tilt wing. Its area, and the loads on the wing accordingly, could be altered in flight by selecting the optimal value for various configurations. This also made it possible to achieve a decrease in the frontal resistance of the aircraft. The variable-geometry wing was not being employed for the first time; the OKB had already tried it out on the Su-17. But whereas only the wingtips deflected on that aircraft, it was almost the entire outboard wing panels on the Su-24.

One has to use the words "for the first time" a great many times when recalling the creation of the aircraft. The Su-24 is really one of the first third-generation aircraft. It is now a little obsolete, but twenty years have passed, after all. The aircraft can perform missions completely successfully under contemporary conditions after upgradings. And all thanks to the progressive solutions inherent in its creation.

The Su-24 is a shoulder-wing aircraft executed according to a normal aerodynamic configuration with a monocoque fuselage (the shape that was chosen is to ensure maximum lift), two AL-21F3 turbojet engines developed by the design bureau led by A. Lyulka, with two noncontrollable lateral air intakes, a variable-sweep wing, a swept tail assembly and separately controllable stabilizers. A ventral fence has also been installed in addition to the vertical empennage in order to provide for directional stability.

The whole process of creating a new airframe is intrinsically a chain of contradictions and compromises. The aircraft naturally had to be made somewhat heavier, using quite powerful tilting assemblies for the wings, but the impact obtained dispelled any doubts.

The wing of the bomber is one of its noteworthy features. Each of the wing panels consists of an immobile portion, fastened to the fuselage, and a tilting part. The latter are fastened with the aid of bearing assemblies to a load-bearing beam of the center section and are equipped with specially developed tilt pylons for hanging ordnance. The design of the pylon, using a parallelogram mechanism, makes it possible to keep the direction of the axis of the weaponry unchanged at any angle of wing tilt.

A sweep angle of 16° was chosen for the leading edge in order to provide for the maximum bearing properties of the wing in takeoff and landing mode. The wing area is increased therein, as are, naturally, its lift and the aerodynamic properties of the aircraft. Each tilt panel is fitted with four-piece leading-edge flaps and three-piece, double-slotted trailing-edge flaps deployed with the aid of screw drives. Spoilers have also been installed on the upper surfaces of the wing panels.

A sweep angle of 35° is used at subsonic cruising speeds. An angle of 45° provides quite high bearing properties and aerodynamic quality when performing maneuvers. The high maneuverability makes it possible to escape an attacker and select a more "energetic" flight profile for approaching the target, including dive- or toss-bombing. Flight at high subsonic and supersonic speeds (up to Mach 1.35) is made at the maximum wing sweep of 69° in order to provide for minimal frontal resistance.

The lower portion of the fuselage has four pylons with assemblies to fasten stores racks, launchers, transfer pylons or pods, among others, as well as two speed brakes that are simultaneously the forward doors of the landing-gear strut bays. Another two pylons are installed under the center section with assemblies to attach various racks. Two extra 3,000-liter external fuel tanks in particular can be mounted on the center-section rack assemblies of the aircraft, along with one 2,000-liter tank on the ventral rack.

The concept chosen for overcoming air defenses required the installation of a multi-mode radar system, a new type of navigational equipment and provisions for automatic flight control of the aircraft. This forced a

fundamental reconsideration of views on the organization of design engineering and development of the airframe. An integrated approach to the solution of technical issues with the bombsight and navigational equipment was realized for the first time in aircraft-building practice. The name "aviation system" started namely with the Su-24. Before that, after all, the aircraft builders had operated this way: first an airframe was created, and then the bombsight system, weapons-control system and navigational equipment were stuffed in... They should not be reproached for this, as the task of integrating them is exceedingly complex and could be resolved only on the basis of fundamentally new technology and the organization of operations in a new way. The appearance of on-board computers made it possible to adopt this approach. Ye. Zazorin was designated deputy general designer for equipment. He combined the efforts of the chief designers of all 13 subsystems, and together with the specialists of the OKB he created a unified bombsight and navigational system (PNK) for the aircraft. This made it possible—aside from the large economy of mass—to eliminate redundancy and raise the precision and operational effectiveness of the PNK considerably.

Much was done for the first time. There were, of course, difficulties with the creation of both the digital computer itself and its programs and the fine-tuning of the system. Communications between aircraft systems, ground equipment and the pilot now began to be so complicated that it was exceedingly difficult to ascertain, for example, the reason for a missed target. The programs also had to take into account the possibility of such an analysis. Why not a hit? Was it the result of imperfections in aircraft design, pilot error or something else? The creation of a sufficiently precise and productive system for objective monitoring and the processing and documenting of information was required.

The navigational equipment of the Su-24 provides for precise and reliable air navigation and the possibility of approaching the target area in autonomous navigational mode according to a pre-programmed routing. The bomber is controlled from the pilot's and navigator's stations, located side by side in the same cockpit, either manually or with the aid of automated equipment. This redundant control panel makes it possible to get by without a special two-seater aircraft during the training process; it is enough to install a traditional stick at the navigator's station.

The pressurized cockpit with an air-conditioning system and oxygen equipment facilitates normal crew operations in high-altitude flight suits across the whole range of altitudes. The canopy of the cockpit consists of one fixed part and two flaps that swing back and to the side independently of each other. The two K-36D ejection seats, as well as the interlocking system for jettisoning the swinging part of the canopy, provide for the separate forced abandoning of the aircraft by the crew members. It must be said that the seats, making it possible to eject even when on the ground, were first employed namely in the Su-24.

There were many difficulties with determining the procedure for forced ejections. The principle of "every man for himself" was proposed first, followed by having the pilot "eject" the navigator and be the last to quit the aircraft... These methods led to the loss of valuable seconds, however, the price of which is the lives of the fliers. They thus ultimately came to this version: whoever makes the decision to eject, the preparation system is actuated, the crew members are pulled fast to the seats and the necessary commands are completed. The system rules out aerial collisions of the pilot and navigator in ejection.

The bomber overcomes the resistance of enemy air defenses through the use of an individual protection system and good tactical performance characteristics, as well as a whole set of design-configuration and special measures for combat viability. The latter include protection against weaponry for the crew members and fuel tanks, the presence of two engines, the installation of two stations for controlling the aircraft (for the pilot and the navigator), system redundancy, the placement of the control lines in a back fairing and a minimal number of joints between fuselage panels.

The effective destruction of targets is ensured by the high-accuracy PNS [bombsight and navigational system] and a broad range of arms, with the possibility of employing various types of them in a single sortie. Some of the weaponry was developed especially for the Su-24. The aircraft is also equipped with a built-in 23mm aerial cannon. Another three cannons can be mounted on fasteners in special pods.

OKB test pilot V. Ilyushin took the plane up for the first time in May of 1970. One of the most difficult and crucial stages—the flight and final adjustment testing—was then entrusted to Deputy Chief Designer (today General Designer) M. Simonov. His organizational talents, broad technical outlook and energetic lifestyle were revealed to the full in that work.

The flight and final adjustment testing of the Su-24, which was conducted by test pilots V. Ilyushin, Ye. Solovyev, V. Krechetov, S. Lavrentyev (died during testing) and N. Rukhlyadko along with test navigators N. Alferov, V. Belykh, L. Smyshlyayev and L. Rudenko, showed that the specialists of the OKB and other organizations had created a good aircraft that conformed to the world standards of the time, and especially to the American FB-111 of analogous purpose. The aircraft was put into series production in 1972, after the elimination of the drawbacks noted in testing. Its heavy service had begun.

A continuous search for new principles for the utilization of airframes and improvements in their equipment and weaponry is underway around the world, however. Military hardware must be improved constantly in order not

to lag behind a likely enemy in development. The OKB thus set about further improving the Su-24 aircraft and raising its combat effectiveness in 1975. Guided weaponry with laser and television homing systems was developed, and the accuracy of bombing and strafing systems was increased. The electronic equipment was upgraded, and an on-board individual-protection system appeared that gave the crew information on the illumination of the aircraft by enemy radar and the use of missiles against it.

An aerial refueling system was created to increase the range of the aircraft, which made it possible to expand the tactical capabilities of the aircraft. Close-support tactical bombers could not be refueled in flight before the Su-24. What does that operation provide? When the maximum takeoff mass is restricted by conditions of wheel strength etc. and it is necessary to have a full ordnance load on board or provide for greater flight range, it can take off with a less-than-full load and have the tanks refueled in flight. The variation that received the designation Su-24M (Su-24MK in its export version) was put into series production in 1978. An Su-24 aircraft with a standard UPAZ-A unit mounted under the fuselage is also envisaged as the refueling aircraft.

Work on the tactical bomber continues. The operational feasibility of the aircraft is being improved constantly. A large number of proposals from specialists in line units was collected according to the results of developer's follow-up oversight. Many of them have already been realized. We are clarifying the time periods for the performance of servicing procedures and the periods between those servicings along with increasing the service life and reliability of the aircraft and its constituent elements, especially the bombsight and navigational system.

The long-lived aircraft that at one time laid the foundations for today's triumph of the Su-24, still in service, is able to perform many missions. According to the statement of foreign specialists the Fencer, as they call it, is closer to Western models of aircraft in its class in characteristics, combat load, equipment and armaments than other Soviet aircraft. That assessment coincides with ours.

**Principal Characteristics of the Su-24 Aircraft %**

| | |
|---|---|
| Length, meters | 22.670 |
| Height, meters | 5.920 |
| Wingspan, meters: | |
| —at wing sweep of 69° | 10.366 |
| —at wing sweep of 16° | 17.640 |
| Wing area, m$^2$ | |
| —at wing sweep of 69° | 51.024 |
| —at wing sweep of 16° | 55.168 |
| Width of landing gear, meters | 3.310 |
| Wheelbase of landing gear, meters | 8.510 |
| Takeoff mass, kg: | |
| —normal (combat load of one ton) | 32,260 |
| —maximum | 39,700 |
| Fuel mass, kg: | |
| —integral tanks | 9,850 |
| —external tanks | 6,590 |
| Maximum engine thrust, kgf | 2 x 11,200 |
| Maximum ordnance load, kg | 8,000 |
| Flight speed at ground, km/hr | 1,380-1,420 |
| Maximum Mach | 1.35 |
| Takeoff run, meters | 850-900 |
| Landing runout, meters | 800-850 |



## State of Practice Bombing Ranges Assessed

*92UM0063C Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 5, May 91 (signed to press 10 Jun 91) pp 28-30*

[Article by Lieutenant Colonel I. Kovalenko under the rubric "For High Combat Readiness": "It Does Not Seem Possible to Close the Ranges"]

[Text] *Flights with weapons delivery are becoming, as they say, more and more of a rare holiday for pilots—there are not enough practice ranges. Their number will decrease by another third with the withdrawal of our aircraft from the Eastern European countries. This is making "range starvation"—and, consequently, the problem of how and under what conditions a rise in the level of aerial-firing proficiency among the crews can be achieved—considerably more acute. It would seem that the acuity of the problem could be abated if each flight to the air-combat training range were made at maximum effectiveness. And it must be looked at from more than above for that...*

It is difficult for a person far removed from army life to evaluate the role of practice ranges in the combat training of the troops. How ready the pilot is to employ the weaponry entrusted to him in battle, at what level the fighting ability of a squadron or regiment is as of today and, as a result, the defensive capability of the country, meanwhile, all depend on their qualitative condition.

Unfortunately, not everyone understands this. The stream of letters addressed to the head of state with demands to take away or eliminate the military practice ranges is testimony to this. The Semipalatinsk range has been "frozen," and now on to a new offensive. And none of the arguments of the military defending the lands that were once allocated to them by law are taken into account—close them, and that's that. Such are the realities of our life today.

It must be acknowledged that we are also somewhat guilty, in the swirl of everyday troubles, of inattention to the needs of those who are "stuck" day and night at the remote "points," "notwithstanding all of the burdens and deprivations," who ensure the prescribed rhythm of combat training for the flight units. And the personnel of the practice-range service are on this long list of the "forgotten." It must be owned that only a few fliers have any conception of its work.

The chief of the practice-range service of one of the weapons-delivery centers, Lieutenant Colonel Yu. Boldyrev, and I were a little more than two hours enroute from the principal base to the Moiseyev "operation" by "UAZik". Our choice was not accidental; even though there is another range much closer, the trip to the "target" headed by Major V. Moiseyev, in the words of Yuriy Ivanovich, was an excellent opportunity to become more closely acquainted with the achievements of the ranges, as well as the misfortunes.

When Vladimir Yuryevich learned the purpose of my visit, he admitted with inconcealable irony that he did not have enough fingers on his hand to list all of the problems. And he proposed that I myself become engrossed in the operational dynamics of his subordinates with the start of flights at the airfield and, if there was time, to take a look at the "operation" from the viewing area.

Going up to the third floor of the command post, I pressed the eyepiece of the binoculars against my eyes. I admit that had it not been for Moiseyev's help, I would not have been able to find the targets set out across the firing and bombing range. The "enemy" is clever, whatever you say, he is camouflaged as he should be. It was easier to get oriented by looking at a diagram of the target layout. Here was the "airfield," there the "nuclear-missile battery," the "column of armored vehicles" and the "air-defense facility..." And all done by the hands of subordinates of Major V. Moiseyev. Only recently have the "wooden" aircraft been replaced by Su-7s that have outlived their time, and the rest are all mockups that have to be patched up constantly; the flights are literally in a day, after all.

You sometimes hear in the flying environment from time to time that our ranges are not up to modern requirements. The principal reproach therein is expressed on the score of the immobility of the target layout. Well, yes, one can agree with that, but only partly, since I would remind you that there are tactical ranges, apart from the firing ranges, for training pilots in finding targets and carrying out an attack without the delivery of ordnance. The combination of the two types of ranges into one with the ensuing practice of all the tasks facing frontal aviation on it, which is just what is being proposed sometimes, is unfortunately unrealistic in the face of our technical backwardness, when virtually everything has to be done by hand. Such equipment, however much it may be desired, cannot be manufactured homemade in the unit or in a workshop. It should be supplied in centralized fashion from our defense enterprises. But there is no one to wait for help from. We thus have to display our own initiative and even, if you wish, enterprise.

Lieutenant Colonel Yu. Boldyrev made a deal with representatives of one of the local enterprises of heavy industry to exchange scrap metal (about 56 tons of ferrous and 2.5 tons of non-ferrous were collected on the range over the last year alone) for modern computer equipment. How can one fail to value the efforts of the chief of the range service to get things moving to solve the somehow problem of automating the process of supporting weapons-delivery flights? However... The stamp of prohibition was placed on this initiative for the umpteenth time.

Major Moiseyev recalled the difficulties he had encountered when he decided to refit one of the targets using his own manpower—a circle for night bombing. Need forced him, as they say, to take on this difficult work. What kind of a target was it? All very simple, it turned out—liquid fuel burns in flat dishes placed around the circle. But here is the bad luck: a pilot on a combat heading is sometimes unable to perform precise aiming at the end of a prolonged night shift—the greater portion of the containers are already going out by that time. They have to be relit, diverting people to it in the face of an acute shortage.

The practical way out of this situation is to electrify the targets. But where to get the funds? They had to resort to the tried-and-true method—the "contract" method—that is to say, get everything for themselves. They collected bits of scarce cable, bought lights using their own money...

And they did not have to wait long for the results; some 62 tons of diesel fuel were saved over the year alone. And that was at a single range! What about on the scale of all the Air Forces? The realization of this proposal, after all, is not only a step toward toward the economy of material resources, but also a substantial contribution toward raising flight safety. And one should not forget that.

Far from last place in an objective assessment of the quality of weapons delivery is assigned to methods of determining the coordinates of the points for the burst of the ordnance. We will take a look at how that process transpires in the course of the daily flights.

Say a pilot has carried out precision bombing. The azimuth of the blast point of aerial bombs is fixed from two, or ideally three, observation posts. The information thus obtained is transmitted to the command post, where the results of the bombing are determined on a map plotting table of the target layout. It is not difficult to guess how well it corresponds to reality using such a method of measurement. The reliability and operability of the whole "pilot-aircraft" system, after all, are later judged according to those results. And if no errors are revealed in the pilot's aiming according to the objective monitoring system but the evaluation received was far

from a high one anyway, they try to pass off all of the sins onto the bombsight and navigational system (PNK) of the aircraft. And they drag the "offender" off to the TECh [technical maintenance unit] for extra adjustment of the sight.

But that is not so serious. If the pilot carries out the firing using aerial rockets or cannon, then... The last word in determining the results belongs to the flight supervisor on the range. He eyeballs, as they say, the accuracy of the firing, sometimes informing the pilot by radio right away—"not bad" ("good"), "a little off" ("satisfactory"). Those are the evaluations... Other evaluations are sometimes put into the reports, it is true, according to the ranks of those who did the firing, as they say. But all of that happens, remember, on the routine daily flights.

It is another matter when they are conducting performance evaluations of regiments at the air bases. Here the results of weapons delivery are now determined in a different manner—the target is either destroyed or it is not. And right here is where the clear discrepancy often arises between His Majesty the average rating, according to which we are accustomed to evaluating the aerial firing proficiency of the fliers, and its true condition.

Such is the picture that takes shape. Does it suit everyone? I am sure it does not, since the solution of the problem has finally moved from a standstill. And I say this because I have been able to see the work of a technical innovation—the practice-range automated target-monitoring television system (PTASOK)—in the course of the flights with my own eyes. Its development, manufacture and installation on the range was a result of the labor of staffers at one of the scientific-research institutes of the Air Forces and specialists at the range. It is not my aim to describe the operating principles of the system. I would only note that the first year of operation of its experimental prototype showed that the accuracy of measurement of the coordinates of weapons blasts increased five-fold! The automation of the process made it possible to free up some of the personnel who had been active in making those measurements. And that is a fact of no little importance. The roads of the range are also wasteland in the wasteland that is the range—sometimes in the off seasons, when all the roads to the target have gone sour, an observer can get to the station only by air, by helicopter. An expensive convenience, isn't it?

In talking about the innovation, however, one cannot fail to dwell on the prospects for its development. The integrated utilization of the PTASOK along with the aircraft PNK and its standard on-board equipment, as well as ground-based electronics, will make it possible to: increase flight safety markedly when the crews are performing airborne weapons delivery (ASP) through the availability of information on the parameters of aircraft flights on the combat heading and in maneuvering over the range to the flight supervisor; increase the reliability of the results of the combat application of ASP; achieve a considerable economy of ordnance through the execution of tactical bombing with documentation of the conditions of its drops; and, expand the possibilities for automating the statistical processing of available results of bombings and strafings conducted on the scale of squadrons and regiments. The projected future fitting of the system with passive infrared instruments will make it possible to increase the precision of the measurements even more in flights under any weather conditions, day or night.

It is entirely obvious that the adoption of the PTASOK is the behest of the times, a real step forward in solving the problem of raising the quality of the combat application of aircraft weaponry against ground targets. So there exists the idea and the customer—the Air Forces. But the search for an enterprise of the Ministry of the Defense Industry that could take on the production of such necessary equipment has reached a dead end. Respond, whoever is not indifferent to the state of combat readiness of our Air Forces, extend a helping hand!

And another question that cannot escape our attention. Our country stands at the threshold of market and land reform. To what extent will their coming affect the lands that are being used by the Ministry of Defense? It is still difficult to answer that with definite clarity; either the army will be released from paying for the land, or some sort of concessions will be instituted; one way or another it should acquire a solid legal footing.

But the letters are still coming in from people's deputies and citizens to the USSR Cabinet of Ministers with the proposal to eliminate the military practice ranges. The aviation command has had to limit the caliber of the ordnance used on training flights and alter the directions of approach to the targets in reply to those appeals... However you look at it, these measures have a negative effect, to some extent, on the "cardiogram" of the combat training of the fliers and are sometimes detrimental to combat readiness. "It does not seem possible to close the ranges" in order to keep it from decreasing, to preserve it at the required level. A painstaking search for ways of raising the effectiveness of their utilization must be performed under these difficult conditions.



## Lack of Flying Time Affecting Pilots' Proficiency

*92UM0063D Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 5, May 91 (signed to press 10 Jun 91) p 30*

[Article by Combat Pilot 1st Class Guards Major A. Gornov under the rubric "Combat Training: Experience, Problems": "Prohibition-Mania"]

[Text] Words that are, in my opinion, noteworthy are written on one of the displays at the headquarters of our air squadron: "Flight safety is achieved not through oversimplification, but through high proficiency." Unfortunately I do not know the author. But I can declare with confidence that this was said by a person who knows the specific nature of flight operations very

well. It is a matter of its very essence, and not its authorship, in any case. I think it cannot be disputed. It is just a shame that this slogan is sometimes not confirmed by existing practices. Judge for yourself...

I recall that a commission from higher headquarters had been working in our squadron. Later, after the results had been summarized, commission representatives pointed out to us various omissions, including gross precursors to accidents, of which the pilots were guilty. Although there were not many such cases, facts remain facts. I will not take it upon myself to make excuses for my comrades for their mistakes, the more so as they got what they deserved, as they say. But I would note that their mistakes can be explained to a certain extent nonetheless.

The specific nature of flight work is simply incompatible with prolonged interruptions in flights according to the logic of things. It is not for nothing that a special schedule is drawn up for fliers who have missed several flight operations shifts, for whatever reason, to get back into service.

Life sometimes refutes logic. Not life itself, more accurately, but the people who go against it.

I pick up two pilot's logbooks at random. The first belongs to Guards Major Sergey Klimov. And what do I see there? In one month the pilot made ten flights with a total flying time of seven hours. Even less in the next—six day flights and one at night. Total flying time for the month, four hours. I turn the next page; Klimov flew just twice and spent a little over an hour in the air. A sad picture. And you cannot call it an exception.

We look at the logbook of Guards Captain Viktor Virchenko. Over two months he was able to fly four times. He was able to spend only three hours and nineteen minutes in the air. Other fliers in the squadron have flying times that are just as miserly (you can't call it anything else). Just what sort of improvement of professional skills can we be taking about here? If only they could keep from losing what they had built up before. But they are losing it. The pilots who had committed precursor actions to accidents in flight included first-class pilots as well—Guards Major V. Gryzlov and Guards Captain Yu. Kucherov. That is what a shortage of practice means. The simulators, such as do exist, are of little help.

I can foresee the question: so what if you don't fly? Let the commanders plan a few more flight-operations shifts and—onward. That is what is done in general, but life makes its own adjustments. Sometimes the reasons for the cancellation of flights are objective ones—the weather, for example, lets you down. It is more often "paper" elements that interfere, rather than the natural elements, however. Say there has been some flight accident, and the order comes flying in to the unit—"knock off" the flights until the circumstances are clarified. This step undoubtedly often makes sense. But always? Do they have to be banned in, say, fighter aviation if the trouble occurred among the helicopter or transport fliers?... The conclusions from what happened have no direct relation to our squadron; they can be drawn, as they say, on the go, but valuable time is wasted for nothing. Sometimes for weeks, moreover, and not just an hour or two or a day. It often turns out that the senior officers issuing such orders, concerned in general with a good cause—ensuring accident-free flight operations—actually are acting to the detriment of it; a pilot with an interruption in his flight operations, after all, will commit these precursor actions more quickly.

The fact that a similar "prohibition-mania" gradually infects the lower-level supervisors as well—commanders of regiments and squadrons, and even flights—is especially depressing. After all, they usually "beat on" the chiefs more painfully for a precursor action committed by a subordinate than for the cause of it—lack of pilot proficiency. They also prefer to take the path of least resistance, intentionally simplifying the flight assignments for their pilots, or else releasing them from flights altogether without any substantive grounds for it. Some therefore look for the chief cause of this "mania" phenomenon namely in them. I am sure that these officers have themselves become victims of a whole chain of tightly extant interrelationships.

But we return to the squadron. The essence of our problems, of course, does not consist of unwarranted orders coming down "from above" alone. There are enough "surprises" from the subunits supporting the flights as well. Today you could perhaps not even count how many days we were forced to sit on the ground only because the airfield was not ready for flights. Either there is not enough equipment, or it breaks before the start of the shift. It would be unfair to blame the subordinates of Captain A. Marchenko and the other specialists of the obato [detached airfield technical-support battalion] for all these sins. I know that the commanders of the unit make every effort to "break out." But they are not always successful in this. What can you do if the equipment has been operated for quite a few years, and not always by skilled hands either, and replacing it is another whole problem?

I will permit myself a small digression on this score. Cutbacks are underway in the armed forces today. Some of the army's equipment is being transferred to the national economy, or else simple sold off at auction. This is proper, of course, but something else could also not fail to be proper—to replace equipment among the troops that has served out its service life with newer equipment from disbanded units. I am sure that this step would eliminate a serious problem in the army, and would make it possible to raise the combat readiness of units and subunits. The leaders of our obato, by the way, took similar proposals to the most varied levels. But without result. The syndrome of prohibitiveness is triggered in some flight all the same. And what is instructive is that all of the leaders support the proposal in word, but the issue is spinning its wheels in deed. Would you like to know where?

There is, in my opinion, yet another reason for the poor professional proficiency of the pilots, which also naturally affects the safety of flight operations. The principal document among those that prescribe procedures for our combat instruction and the course of combat training permits the pilots to display intelligent initiative in the choice of tactical devices and the most optimal methods for resolving the missions they are assigned. Some senior officers, however, not very cunning in their thinking, treat everyone alike and ban the performance of this or that maneuver without taking into account either the individual capabilities of the pilots or the level of their qualifications. This can naturally bring nothing but harm. Then it obtains that experienced fliers slip willy-nilly back to the level of the average ones, and the young ones, barely strong enough, cannot strive for anything more. The chief is satisfied. Tranquillity is higher than everything for him. The principle of "it will come to no good" has pushed all other issues into the background for him. So directives like "clause... article... eliminate" and "article... understand..." etc. come to the units. It is honestly a terrible thing to open the KPB—the pages are festooned with crossed-out paragraphs. This is, so to speak, our "prohibition-mania graphically depicted." Sometimes it even seems that the words about the necessity and possibility of initiative are written in the KPB only to play it safe as well—as if the pilots do not realize that they have been deprived of initiative in training and in battle.

Yes, the words about flight safety that are written out on the display at our headquarters are undoubtedly correct. Only we take them with a certain dose of irony today. Why? I think everyone understands now...

**From the editors:** *We have no doubt of the sincerity of the statements of the leaders of Combat Training on the granting to unit commanders of the broadest initiative in organizing the aerial proficiency of their subordinates. But the stream of letters from the "lower-downs" saying the opposite is not diminishing either. What is the essence of the paradox? The editors hope to receive answers to that question from the leadership of the Air Forces and the middle-echelon commanders.*



## Causes of High Helicopter Accident Rate Analyzed

*92UM0063E Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 5, May 91 (signed to press 10 Jun 91) p 31*

[Article by Colonel O. Churkin, a senior check pilot of the USSR Ministry of Defense Aviation Flight Safety Service, under the rubric "For Accident-Free Flight Operations": "There is No Safety Without Responsibility"]

[Text] *Whereas the average flying time per accident, without counting combat losses, was more than 107,000 hours in 1966-70, it had decreased to 54,000 hours,* i.e. *by half, in 1989-90. What is the reason? Colonel O. Churkin, a senior check pilot of the USSR Ministry of Defense Aviation Flight Safety Service, reflects on this.*

Helicopters have truly become a mass means of performing many of the missions entrusted to aviation. The rise in their capabilities and the development of new methods of utilization have altered views of helicopter technology considerably and expanded the realm of its application. Support for the combat operations of ground troops is not even conceived of today without the direct participation of army aviation. The clean-up of the consequences of the Chernobyl AES [nuclear power plant], the rail catastrophe in Bashkiria, the earthquake in Armenia and other natural disasters would have been simply impossible without without the use of rotary-wing aircraft.

It is entirely understandable that requirements for flight safety should also be increased under those conditions. After all, air accidents—the causes of which are often disorganization, failure to execute, lack of preparedness, negligence and lack of discipline among the personnel—disrupt the rhythm and reduce the quality of combat training for fliers and inflict definite moral and material harm.

The statistics, however, testify to the fact that we still cannot speak of progress in ensuring flight safety. Why does the accident rate remain so high anyway, in the face of technically reliable aircraft?

This is obviously connected namely with the mass application of helicopters, which have become in the eyes of many commanders a "ubiquitous means" able to operate under any conditions and in any situations even without careful preparation for flight. Elements of bravado and a kind of boastfulness have for that matter begun to be manifested more and more often among the helicopter pilots themselves, most of whom served in Afghanistan and have become true masters and virtuosi. Some begin to study the flight area less carefully, others feel that they do not need "superfluous" training. And as a result...

The crash of a Ka-27 not far from Vladivostok, for example, testifies to the crying lack of discipline. The crew, on their own, altered the routing on one leg of the flight, "came out" onto a highway, descended below safe altitude and collided with trees, a bus and a steel girder. This led to a loss of control of the helicopter and its hitting of a motor vehicle advancing in the opposite direction. Nine people perished as a result.

When you start thinking about why such things occur and analyzing them, you come without fail to the conclusion that virtually all of them arise due to neglect of flight rules and regulations. It must be stated outright that hooliganism in the air has become a typical trait in the behavior of some pilots. This occurs because the individual responsibility of fliers for the meticulous fulfillment of flight assignments has diminished in a number of units, and there is no stern and principled

assessment of their shortcomings. Public opinion sometimes takes the stance of justifying the offenders or sympathizing with them.

The complacency of commanders and the blunting of vigilance on issues of ensuring the safety of each flight are engendered by excessive self-confidence, the lack of monitoring of actions, the false shame of crews for supposedly unnecessary caution and other phenomena that also lead to disruptions in the procedure for fulfilling flight assignments and safety measures.

Such things happen most often in places where objective monitoring has not been organized as it should be. This was the reason for the crash of an Mi-8 helicopter inspecting a range in daytime in good weather. The crew commander, having decided to hunt some saiga, changed the assignment on his own on the second sortie, first turning off the objective monitoring equipment [SOK]. Making the flight at an impermissibly low altitude, he was unable to handle the craft and caught the main rotor on the ground. The helicopter crashed and burned. Two passengers taken on board illegally sustained burns and were hospitalized.

It was clarified in the investigation that the crew had been sent temporarily to a climate zone of the Soviet Union new to them just to perform two flights. And an aviation unit equipped with the same type of helicopters, whose crews were fully capable of handling such an assignment, was even based in that region.

But the misfortune is that some commanders are simply unaware of the economic inexpediency and danger of such trips. The *rigor mortis* inherited from the days of stagnation, when every department tried to perform any and all tasks exclusively through the involvement of just their own manpower and equipment, is having an effect here. The failure to think through these decisions also creates fertile ground for the uncontrolled behavior of crews apart from their units. The commander of the helicopter, after all, turned off the SOK only because he knew that no one would be monitoring him in that case.

And another crash for very similar reasons. The crew of an Mi-24, once again on their own, deviated from the assigned flight path, descended to the lowest possible altitude and caught the wires of an electrical-transmission line. Feeling the blow, the commander moved the helicopter sharply to gain altitude with a reduction in airspeed. There was a powerful shaking, and the speech warning indicator issued the report, "Main hydraulic system failure." Two crew members abandoned the helicopter on command. The weapons officer landed safely, but the flight technician died; his parachute did not open. The crew commander was able to land the craft at a selected spot.

An incident analogous to this one had even already happened not long before. The only difference was that the crew commander at that time was among the ranking personnel of the regiment, and this time it was a rank-and-file pilot. This repetition of the causes of helicopter accidents and crashes testifies to the fact that some units, receiving information on air accidents and the precursor actions to them, study it superficially without taking timely steps to eliminate shortcomings.

An effective rise in flight safety can be achieved only through the unswerving fulfillment of the requirements of guiding documents, the skillful organization of training and indoctrination for the personnel and the creation of an atmosphere of trust, wherein the pilots themselves will have a vested interest in a comprehensive analysis of any violations in the sky. And that is possible only with a coordination of efforts by all fliers, led by the commanders who bear full responsibility for the state of flight operations.



## Faults of Search-and-Rescue Equipment and Procedures Detailed

*92UM0063F Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 5, May 91 (signed to press 10 Jun 91) pp 32-33*

[Article by Candidate of Technical Sciences Colonel S. Shumilo under the rubric "Problems of Flight Safety": "Heed Us on Land!"]

[Text] *When the rescue personnel lifted on board the helicopter the body of a crew member from a crashed Tu-22M bomber of the Air Forces in the Pacific Fleet, they saw a crash helmet with a hole in it, a life jacket that had not been actuated and a buttoned-up rubber raft that had not deployed. The pilot had no other gear. The helicopter personnel were unable to pick up the second pilot who had ejected; he was dragged underwater with his parachute in front of their eyes. The remaining crew members were not found. Why had the crew left to perform its assignment without ocean rescue suits, in which it is possible to be in polar waters for more than 12 hours without threat of freezing?*

The farewell salute thundered over the pilot's grave, and the crews are once again heading off on long-range flights no better equipped with rescue equipment than the one who died. What are they hoping for? Yes, as always with us, that nothing will happen. Even though comprehensive support for the faultless functioning of the aviation complex on land and in the air nonetheless does not rule out the likelihood of a special situation arising and, as a consequence, the abandonment of the aircraft by the crew. And then the rendering of timely assistance to those who have been stricken becomes the paramount but, unfortunately, often impossible task.

It is difficult to find an aircraft that has gone down. It is even more difficult to do it quickly, and that is extremely necessary. The statistics testify that the chances of rescue are equal to 50 percent if the aid to the stricken is within the first eight hours, and drops to 10 percent when the time period increases to two days. The task of giving aid to the passengers and crews of aircraft in long-haul,

military-transport and civil aviation is especially urgent, since their routes often run over difficult-to-access regions, mountainous terrain or water.

The organization of search and emergency-rescue operations remains at a low level, however, despite the steps that are being taken; unwarranted losses of people and expensive equipment, large material expenses and damage to morale continue to occur as a result. The second principal cause of the prevailing situation is our country's lack of modern means of search, detection and rescue of the stricken, which also makes the rapid determination of the area of a crash and the effective performance of rescue operations more difficult...

The search had lasted about five hours for the Yak-40 aircraft that had gone down in the middle-compass area of the airfield in Nizhnevartovsk. They could not find an Mi-2 helicopter near Vologda for more than three hours. Why so long? No one had heard the distress signal, even though several dozen of our copters were operating in the area of Vologda at the time. And only after an Austrian A-310 Airbus flew over the location of the accident did information come from it on the crash.

The search for an Mi-8 helicopter did not start for more than eight hours in the Krasnoyarsk Civil Air Administration. The distress signal was not heard by the radio stations of the local airfields, the ground receiving stations of the KOSPAS-CAPCAT satellite system or civil or military aircraft, even though an emergency radio beacon was turned on by the crew immediately after the forced landing. Once again it was only a passing craft, this time Belgian, that received the signal for assistance. Why just them? Could our pilots be deaf to the fate of their own colleagues?

We will compare the capabilities of Soviet and foreign aircraft in order to answer that question. Foreign aircraft are equipped with radios that make it possible to listen to the 121.5 MHz emergency frequency constantly while in the process of carrying out basic radio communications. Our own crews (both military and civilian) should (can!) do this only during a pause in radio exchanges. There are unfortunately not that many of them when in flight. The necessity of refining the radio sets on Soviet aircraft has thus become an urgent one.

But that is not enough. It is necessary to listen to the whole surface of the earth in order to have the guaranteed reception of an SOS signal. That cannot be done with aircraft and ground receiving stations alone. That is namely why the KOSPAS-CAPCAT satellite system was created to determine the location of naval and airborne craft that are in distress. It was developed in accordance with intergovernmental agreements on the utilization of space: according to the KOSPAS plan in our country, and the CAPCAT project in the United States in conjunction with France and Canada. The Soviet satellite supports the reception of emergency signals at frequencies of 121.5 and 406.025 MHz, and the American can also receive 243 MHz.

All crew members must have emergency radio sets operating at the frequency of 121.5 MHz that are turned on automatically if they abandon the aircraft. They should operate continuously for 15-20 minutes for the satellite system to receive the signal with the most favorable locations of the satellites, and 3-4 hours with unfavorable locations.

Information on the receipt of a distress signal on the indicated frequency, in the absence of a request for a search for an aircraft from the command post controlling its flight, is processed only after two consecutive passes of the satellite over the location of the crash, since the percentage of false signals is quite high (up to 80 percent). And that signifies an additional loss of time. The saving of human life thus depends on the operational precision of the command posts—that is, on the rapidity of notification of the rescue services.

Greater reliability in the receipt of information and precision in determining the coordinates is achieved when the emergency radio station operates at the frequency of 406.025 MHz. In that case the signal (only a foreign craft since, as you recall, this frequency exists in the receivers of our satellites but is lacking in the transmitters of the emergency radio sets) comes in in coded form virtually without interference, and the country to which the air radio locator beacon (ARB) belongs, the name of the object that carries the ARB and the nature of the disaster are determined at the ground stations.

The emergency radio locator beacons and emergency transmitters of distress signals to equip aircraft, in accordance with the initial agreement by the representatives of the four nations, were developed independently by each party. Non-removable, automatically removable (jettisonable in an emergency) and portable distress locator beacons operating at the frequencies of 243 and 406.025 MHz are currently employed in the countries that use the system on aircraft. The development of an automatically removable ARB has been underway in the USSR for more than 10 years. The deadlines for the manufacture and adoption of the non-removable one have not been met, and the series production of the portable radio beacons has not been set up.

It is good that we are making and launching the satellites for the KOSPAS-CAPCAT system and helping others. But when will we learn to be concerned about our own people being dispatched on dangerous long-range flights? And no one is to blame once again after all these years? And none will be the wiser? Few know that the development of the radio beacon was first entrusted to one of the institutes of the USSR Ministry of the Communications Equipment Industry. Then, after growing tired of waiting for results, it was taken up by the Ministry of the Aviation Industry [MAP]. Considerable funds were thus expended, but the aircraft are still not fitted with the radio beacons. The satellites are aloft and waiting for the signals. And the crews are waiting for help.

But it is not enough to hear the signal; you have to fly out, find it and rescue the people. The crews of the search-and-rescue aircraft and helicopters, however, often simply cannot carry out their assigned missions, owing to the poor technical characteristics of the equipment on their craft. Means of supporting the rescue of people when seas are at a sea state of 3-4 have effectively been lacking up until recently. The development of a special amphibious search-and-rescue aircraft has been underway for more than eight years by the Ministry of the Aviation Industry. The financial difficulties that have arisen for the customer and the developer are unfortunately calling into question its appearance in operation in the near future.

Yes, the country is experiencing difficult times and we must economize, but not in people! In order to have the moral right to send people on assignments that entail large risks, we must do everything possible to provide for their finding and rescue in the event of an accident. But the search-and-rescue aircraft now at hand do not have night-vision instruments and are not stocked with an adequate set of rescue matériel and gear. And that means lost minutes, hours, lives...

A pilot came down in the water in the immediate proximity of the shoreline after the crash of a fighter aircraft in the summer of 1989. The water temperature was low in those latitudes despite the fact that it was July. The duty craft—Mi-8T helicopters—that went up on alarm to assist him could not do so, since they could not hover over the location of the crash due to their large flight mass (they had been fitted with two extra fuel tanks to support the assigned radius of rescue operations). And what could they do with an obsolete LPG-2 electric winch, with which the lifting of people was prohibited? A more advanced LPG-150M had not been installed on board due to a shortage of winches of that type. The pilot was rescued by the crew of an Mi-8MT helicopter that happened to be at the base of that unit in transit.

Similar situations unfortunately do not always end favorably; after all, a crew that has suffered an accident is not always in direct proximity to a populated area or the shoreline after coming down. The searches sometimes last for several days. The crews therefore have to be equipped with food, as well as technical gear, to survive prolonged autonomous existence.

Everyone knows the reliability of domestic search-and-rescue, but systematic work on upgrading and improving it is not yet being performed in this country, even though MAP has a specialized developer enterprise. The reason is the same as for most of our misfortunes—nobody is in charge. Thee is no body in the country that would answer for the pursuit of unified technical policy on issues of creating and adopting search-and-rescue equipment. The USSR Unified State Air Search-and-Rescue Service [YeG APSS] should be occupied with these issues on a methodological plane. The statute approved for this service, however, relegates to it just the role of participant in the pursuit of unified technical policy.

It is time to get down to serious business. It would be expedient for the YeG APSS to organize an interagency scientific and technical group that includes specialists from the interested ministries and agencies that would be entrusted—having defined not only its duties, but its rights as well—with the pursuit of a unified technical policy on issues of the creation and adoption of the means of search and rescue, as well as projecting as quickly as possible the minimum search and rescue manpower and equipment, by quantity and type, without which flights would be subject to prohibition. This group—this is of no small importance—could prepare materials for informational references on air mishaps on the operations of the search-and-rescue services and could devise proposals for improving it, as well as tracking the scientific and technical development of projects for search and rescue with a regard for domestic and foreign experience.

Meanwhile, unfortunately, flights are not becoming less dangerous to the extent of improvements in aviation equipment. Reports come in often, very often, that "An aircraft has gone down... In the area of... There are victims."

Victims of the incident? Or victims of indifference?



## WGF Pilot Saves Out-of-Control MiG-29

*92UM0063G Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 5, May 91 (signed to press 10 Jun 91) p 35*

[Unattributed article under the rubric "Courage": "In an Extreme Situation"]

[Text] It happened in a fighter air regiment of the Western Group of Forces. Combat pilot 1st class Captain A. Grankin was performing a post-maintenance check flight of a MiG-29 aircraft after the replacement of the engines on 8 Feb 90. It had been a twelve-minute flight when the pilot switched the engines to afterburner mode at 13,000 meters. The speed reached the assigned value after a few dozen seconds, exceeding the speed of sound by 1.5 times. The monitoring instruments were issuing information—the power plant was operating without malfunctions. It was time to start slowing down and head back to the airfield.

But what's this? The engine control levers could not be moved! They had jammed! All attempts to turn off the afterburners were unsuccessful.

Reporting what had happened to the ground, Aleksey turned them off in emergency mode (now the engines were operating only at "maximum"), deployed the air brakes and began to descend at steady speed.

One of the most difficult tasks in his life—a choice—had arisen to face Captain Grankin in those moments. He had the right to abandon the aircraft, but then an expensive piece of equipment would have been lost; the ultimate cause of the failure would for that matter have remained unclarified, with a repeat of the failure possible on another aircraft. The MiG-29 could have been landed anyway, putting his own life at risk. Aleksey knew that a similar attempt undertaken by an experienced pilot on an aircraft of this type in one of the air units had ended in an accident, but he nevertheless chose to fight to save the aircraft.

At an altitude of 4,000 meters Grankin performed the emergency cutoff of fuel feed to one of the engines, lowered the landing gear and flaps and began to make his approach descent.

The runway appeared up ahead, and the distance to it decreased rapidly. The main thing now was to determine correctly the moment to shut down the working engine; there could be no mistake there. The outer compass marker had already been passed, but the speed was still too high—500 km/hr. What could be tried? One could miscalculate, after all. A 360-degree banked turn! That's how the extra speed could be shed at the cost of increased G-forces.

After the aircraft came out of the turn and was aligned with the runway, the airspeed indicator needle had come close to 420. Time! Grankin cut the second engine. There were some 200-300 meters left until the surface of the runway at the moment it was cut. But it was namely surmounting them that became the culmination of this tense flight, akin to a test flight.

When the aircraft came to a stop after its runout, Aleksey opened the cockpit canopy a little and sighed with relief. That was it! He had won this battle!



## Survey of Development of Electronic-Warfare Tactics

*92UM0063H Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 5, May 91 (signed to press 10 Jun 91) pp 40-41*

[Article by Candidate of Military Sciences V. Dubrov under the rubric "In the Air Forces of Foreign Armies": "In Search of New Tactics"; continued—for beginning see Nos. 3 and 4]

[Text]

### 3. Electronic Warfare

The Americans were forced to undertake significant efforts to fit their aircraft with electronic warfare [EW] equipment in order to reduce the effectiveness of the North Vietnamese air defenses. Spending on the creation of aircraft systems to warn the crews of electromagnetic illumination, jamming transmitters and electronic reconnaissance equipment totaled more than 2.5 billion dollars. But it was recouped with interest by the increase in aircraft survivability, reducing the losses by five times over. A pod with the jamming equipment became just as essential a cargo as fuel and arms for aircraft heading out for their combat missions.

The fitting of the combat aircraft with EW gear marked the second stage in "electronic warfare" in Vietnam. Only specialized aircraft had been employed for it in the first stage. More than 30 American aircraft were shot down over four months after the appearance of guided anti-aircraft missiles among the North Vietnamese troops in June of 1965. The sharp increase in losses forces the U.S. Air Force command to reconsider their tactics of "incursion." Concealed flight under the coverage of jamming came to be widespread in combat operations, along with low-altitude strikes and electronic reconnaissance and target designation.

It was performed at first by EB-66 EW aircraft from airborne patrol stations. Their electronic-reconnaissance sets determined the emissions parameters of operating radars, and the jammers "suppressed" them on their working frequencies. The range of detection of a strike aircraft from the ground depended in this case on the coincidence of its ground track with the "radar being suppressed—jammer" direction. The limit of detection moved out from the radar to the extent of increases in the angle of divergence, and the Vietnamese had additional time to bring the air-defense weapons to readiness. Poor interaction between the support and strike aircraft led to the latter's being shot down at the stage of convergence to the target. The situation was aggravated by the fact that the attacker could not monitor his own position in relation to the strip of maximum "clutter."

The experience obtained made it possible to draw three conclusions: the method of coverage using jamming from a station required increased transmitter power for the coverage jamming on the EW aircraft, first and foremost; the reliability of the camouflaging could be increased by equipping the combat aircraft within individual EW gear; and, a combination of active and passive—an insufficiently effective but cheap means of ensuring the concealment of the aircraft—jamming was essential.

American aviation by and large employed two methods of passive jamming; the first was the creation of false targets in the hope of an answering response from the enemy right up to the use of air-defense firepower against them, and the second was the camouflaging of aircraft strike groups against a background of chaff scattered in the air over a large area. The dropping of separate batches of such chaff frequently led to a disruption of the autotracking of the actual target by ground radar or to a lock-on to the false targets formed thereby. Strips of passive jamming were set in the selected strike sector by special support groups operating about 5-10 minutes ahead of the bombers in raids against targets in the DRV [Democratic Republic of Vietnam].

The aircraft of U.S. tactical and carrier-based aviation somewhat later began to be equipped with detachable pods with active jamming gear (ALQ-71). Since they occupied space on weapons racks and reduced the combat load of the aircraft, it was decided to mount two such pods on just one aircraft in each flight of fighter-bombers, which had an effect on the disposition of forces in the air. The battle formations of the strike groups were tightened up in view of the low power of the external transmitters, which made the execution of missile-evading maneuvers substantially more difficult for them. When the Vietnamese air-defense troops used the so-called "three-point method," the aiming was done at the maximum clutter and, in the event of a fortuitous confluence of circumstances, one SAM could shoot down two aircraft flying side by side (at an interval of less than 460 meters between them). Attempts to protect themselves from the threat of destruction by opening up the formation led to an immediate and sharp decrease in the effectiveness of active jamming. The combat formations therefore began to be restructured to the extent of approach to the targets and depth into the zones of detection, tracking and attack by enemy air defenses.

The sources of concealment jamming were later supplemented with repeater sets. When it was operating in "lock-on" mode, the tracking radar was disoriented by signals being received with gradually increasing delays; several target markers were formed on the radar operator's screen instead of one. The false targets would be locked onto with greater likelihood, as they had stronger "reflected signals."

Four methods of employing jamming were thus confirmed under combat conditions: special aircraft from patrol stations; from the combat formations of strike groups; from on board the combat aircraft itself using individual EW gear; and, the dropping of chaff (passive jamming). They were combined for the first time in the battle plan for the Linebacker-2 air operation, which concluded the long war in Southeast Asia. The tactics of electronic opposition were improved in subsequent local wars to the extent of acquisition of experience in its use, and it was supplemented with new elements.

The whole process of electronic support for strike forces was broken down into several stages.

**The first stage**—EB-66 aircraft took up their patrol stations in the air, bordering the strategic-bombing area from all sides. Two jammers were located one above the other in the same zone in the most important sectors of operations.

**Second stage**—groups of tactical fighters flying at high altitudes and in dense battle formations simulated a raid by strategic bombers, which created a false threat of incursion and forced the radar to be turned on. The EB-66 aircraft simultaneously began active barrage jamming from their stations.

**Third stage**—subunits of F-4G Wild Weasel aircraft launched antiradar missiles (PRR) against the radars that had been revealed, clearing a space for the subsequent overflight of the strategic bombers to the strike target. The breakthrough was accomplished using a "rolling" method—the first wave of PRR carriers operated against the forward radars, and the second against those located in the defense in depth.

**The fourth stage**—F-4E Phantom fighter-bombers equipped with chaff canisters laid down a strip of passive jamming over the breakthrough corridor that had been formed.

And, finally, **the fifth stage**—the strategic bombers, the main strike group, entered the corridor with on-board jamming turned on. Its battle formation included tactical follow-up reconnaissance aircraft with jamming transmitter pods.

The appearance of a new generation of air-defense missile systems within the air defenses of the Arab countries in the October War of 1973, the high saturation of the battlefield and defense targets with radar and the complexity of the spectrum of their signals forced the development of new means and methods of electronic warfare. Methods of EW that had been employed before were not as effective and jamming frequently gave away the jamming aircraft, converting it into a paramount target for enemy air defenses.

Israeli aviation had to return partly to the tactics of "incursion" that were employed by the U.S. Air Force in Vietnam—a combination of electronic suppression with flight at the lowest possible altitudes. The method of "surprise appearance" over the target was founded on the use of contours of the terrain in approaching it, with a subsequent sharp ascending maneuver and attack from a near-vertical dive. Jamming was used only in departure from the target.

The next stage in the improvement of methods for waging electronic warfare was the mass raid by U.S. aircraft against Libya in April of 1986. Special EF-111 and EA-6B aircraft equipped with the latest EW gear at the time took part in it. They intercepted and analyzed radar signals, took bearings on the sources, determined the most dangerous radars and established the sequence for their "suppression." According to the plan for the raid, one EF-111 EW aircraft was included in the overall battle formation with the F-111F fighter-bombers, and flew with them along the routing in "a column of sixes" (five strike aircraft and one for support). The jamming aircraft took up the position relegated to it for loitering at the formation break-up line, which was located beyond the lethal zones of enemy target air defenses, while the strike aircraft approached the target under the cover of jamming.

The EA-6B EW aircraft of the U.S. Navy were deployed, after takeoff from their aircraft carrier, along the coastline of Libya, cooperating with the carrier-based A-7 attack aircraft striking the targets allotted to them. All of the combat aircraft used active jamming with the aid of

individual EW gear. Passive jamming was not employed in the course of this "operation."

The methods of electronic warfare that were born in local wars remain operative up to the present day. Subunits of EF-111A and Tornado ECR aircraft are engaged in perfecting them on the European continent. The 65th Air Division has been formed at the base of the former. The flight zone for training the crews of that unit in waging EW encompasses the airspace of Germany and France. A center for training the command staff of the air forces and armies of the NATO countries has been created, where combat operations under conditions of active electronic opposition are modeled.

Attention is devoted to three principal tasks in the combat training of the flight personnel:

1. The jamming of ground radars outside the reach of enemy air defenses. It is planned to use EF-111A aircraft, at distances of 370-740 km from the area of combat operations and at high altitudes, for camouflaging the E-3A aircraft of the AWACS system, TR-1 high-altitude reconnaissance aircraft, the Compass Call communications aircraft, refueling tankers and other aircraft flying at comparatively high altitudes and not having sufficient protective armaments.

2. The "suppression" of enemy radar when supporting the operations of strike aircraft (A-10, Harrier, Hawk, Alpha Jet) flying at low altitudes, which should permit them to penetrate into the territory of the opposing side undetected and carry out a strike against the assigned targets. The jamming may in this case be located in the immediate proximity of the line of contact.

EF-111A aircraft fly to the area of combat operations at high altitude in order to achieve the maximum range and flight duration, and descend to 150 meters only during the time of attack by the strike groups. This does not, however, provide protection for the strike aircraft against being hit from the ground if they are visually detected.

3. Support for the operations of strike aircraft deep in the enemy rear—the principal mission. EF-111A aircraft fly in the battle formations of the bombers, accompanying them long distances to the staging area for approach to the target, and then gain altitude sharply and create active jamming of radar operations at the moment of attack by the strike aircraft (the "Libyan variation").

The experience of local wars showed clearly that neither the power nor the quantity of transmitters can replace flexibility in their combat application. The substantial role of electronic warfare is thereby acknowledged, and strict requirements are advanced for the training of flight personnel. There are subunits in Europe, aside from those trained American pilots who are in the U.S. Air Force, who are engaged in the training of crews to wage electronic warfare that are united in the so-called "Blue Force", "White Force" and "Red Force" forces.

The task of the "Blues" includes the development of equipment and tactics for battling a likely adversary. The "White" subunits assess the capabilities of the "Reds" to "neutralize" and "suppress" air defenses, while the "Reds," using the recommendations of the "brain trust" (the "Whites"), practice modern EW tactics. Line subunits of tactical aviation are included in them by turns.

Experience has shown that EW gear exists for "half a lifetime"—that is, two generations of electronic countermeasures equipment are created over the time of appearance of a new generation of weapons systems. This means the fast-paced development of equipment for design engineers, the necessity of making use of modular elements for aircraft designers, the rapid and comprehensive assessment of effectiveness for testing institutions and continuous training in the assimilation of new technology and the development of effective methods of using it in combat for aircraft operators.

**Footnote**

1. Based on materials in the foreign press.



## New Officer's Handbook and Flight Safety Book Reviewed

*92UM0063I Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 5, May 91 (signed to press 10 Jun 91) p 42*

[Article by Lieutenant Colonel A. Romanov under the rubric "To Assist Aviation Specialists": "Air Forces Officer's Handbook;" "Aircraft Flight Safety"]

[Text]

### Air Forces Officer's Handbook

Just what is the command of units, subunits and crews in peacetime? How can the performance of the assigned missions be organized? How can the effectiveness of the activity of command and control bodies be evaluated? How can a document be developed and filled in properly? You will find answers to these and many other questions connected with the day-to-day activity of fliers in the *Air Forces Officer's Handbook,* which the Voyennoye Publishing House of the USSR Ministry of Defense plans to issue in 1992.

The first section, "General Provisions for the Command of Troops," sets forth the aims, essence and substance of the command of troops, the requirements made of it, the make-up of the command-and-control system and the role and place of cadres in it. Methods of evaluating the effectiveness of command are presented. The work methods of the command bodies of military units when devising solutions for combat operations, as well as in planning measures to organize and support the fulfillment of the assigned missions, are revealed in detail.

The second section, "Areas and Substance of the Activity of Command Bodies of Units and Large Formations," covers issues of their combat mobilization readiness, and the work of the commander and staff in raising and improving it is shown.

Recommendations are made on the performance of all forms of exercises with the personnel in ground and tactical flight training. A whole set of information on issues of organizing the concealed command of troops and the observance of a regimen of secrecy, camouflage and restoration of fighting ability is included.

Information on the organization and implementation of search-and-rescue support for flights is set forth separately for peacetime and wartime, and contains recommendations for planning, the preparation of manpower and equipment and their command when conducting search-and-rescue operations.

The basic provisions for ensuring law and order include recommendations in various areas of legal work and information on the administrative, criminal and material liability of servicemen for the violation of regulations and laws.

The authors also consider questions of organizing and running a military facility, supplying units with matériel and monitoring their business activity. These issues are organically linked with the performance of such important military rituals as the taking of the military oath, the awarding of state decorations, going on alert duty, the receiving of young replacements and discharge into the reserves, among others.

The material in the handbook is set forth in logical fashion, uses established terminology and is quite fully illustrated with diagrams and tables, providing an opportunity to clarify its contents completely. Some of the information is being published in the open press for the first time.

*To obtain the handbook, an order must be placed with the nearest* "Voyennaya kniga" *before June of this year according to the annotated plan for the issue of literature for 1992.*

### Flight Safety of Aircraft

Voyenizdat Publishing House will put out a work by P.A. Solomon, *Flight Safety for Aircraft,* in 1992 in the event the necessary quantity of requests is collected. This book is the fruit of forty years of work by the author in the realm of ensuring flight safety. It is intended for flight, engineering and technical personnel in line units, specialists of enterprises in civil aviation and the aviation industry and for scientific workers.

It considers the requirements for the flight fitness of aircraft and methods of ensuring them at all stages of the life cycle—design engineering, testing, series production and operation. Recommendations are given for the performance of preventive work to avert air mishaps, and the principal causes of failures are pointed out. An attempt has been made for the first time to explain the physics of phenomena that occur in the failure of assemblies and systems under the effects of the loads on them under various operating conditions, and methods of studying aviation equipment that has failed are reviewed.

*Orders may also be placed through the* "Voyennaya kniga" *stores according to the annotated plan for 1992.*



## Use of Energy of Physical Vacuum as Propulsion System Proposed

*92UM0063J Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 5, May 91 (signed to press 10 Jun 91) pp 42-43*

[Article by Candidate of Technical Sciences Yu. Baurov under the rubric "Science and Cosmonautics": "Through the Energy of a Physical Vacuum"]

[Text] *Man began to use inexhaustible and, as we say today, ecologically clean sources of energy—moving air and water—for various purposes thousands of years ago. The rapid development of science and technology in our time has made it possible to conclude that the surrounding environment, including outer space, is filled with energy. It is namely that energy of the physical vacuum that the author of this article has thought of using.*

The launch of many dozen launch vehicles is required even today to implement the space programs. The cargo traffic in orbit around the earth has increased considerably with time. This objectively progressive process, however, is accompanied by the inflicting of great harm from the components of the rocket fuel being utilized. Many of them, after all, are toxic and expensive, as well as hazardous to use. Pollution of the earth's surface along the flight path occurs—and has occurred more than once—in the event of an accident during liftoff.

The effects on the atmosphere of the "cleanest" American launch vehicles, for example, according to NASA data—the Saturn-5 and the reusable space shuttle (MTKK)—are such that a cloud of expelled gases 2.5 km [kilometers] in diameter is formed in the liftoff of the Saturn-5, and which contains such harmful substances for man as carbon monoxide and nitrogen oxides, among others; launches of the MTKK discharge more than 100 tons of combustion by-products containing carbon monoxide and hydrochloric acid.

The effects of the existing space transport vehicles with rocket engines are the most dangerous to the ozone layer of the planet, which protect all things things living on it against the destructive effects of ultraviolet radiation from the sun. The effects of the solid-fuel boosters of the space shuttle are especially harmful, and the number of launches should not exceed, according to the calculations of specialists, fifty in one year. Even tighter restrictions

for the utilization of the space shuttles are being imposed due to the effects on the earth's ionosphere of such seemingly innocuous by-products of combustion—at first glance—as water. A sharp local decrease in the concentration of electrons in the ionosphere (300-400 km up) was observed in Saturn-5 launches, according to NASA data, due to recombination with the water vapor of the engine exhaust stream. "Holes" with a radius of about 1,000 km were formed for several hours as a result. The consequences of that phenomenon have not yet been studied, but it is already clear that the holes will strongly affect the passage of radio waves. Water discharged into the ionosphere also freezes, and the ice scatters and reflects solar radiation in the visible spectrum.

It follows from the aforementioned that ecological restrictions associated with the harmful effects of existing space transport systems on the environment do not permit intensive freight shipments. What is the way out of this situation? Non-traditional methods of delivering cargoes to orbit must evidently be sought. They could be founded on new laws of natures that, while still not experimentally proven, are now being proposed.

The work of A. Holt of NASA is interesting in that regard. He is considering gravimagnetic systems, as multipurpose power plants in which the gravitational effects associated with certain electromagnetic fields are utilized, along with field-resonant systems, able to make local changes in space-time. The assumptions expressed by Holt in 1980 have unfortunately had no clear-cut theoretical substantiation or yet been confirmed experimentally.

The author has been occupied in a different direction for many years: I have been researching the structure of the physical vacuum, determining the physics of space-time and the basic structure of elementary particles. The ultimate aim was to obtain the possibility of utilizing the energy of a physical vacuum for the needs of mankind, including to move physical bodies. A series of theoretical works (Yu. Baurov, Yu. Babayev and V. Abelkov in the journal DOKLADY AKADEMII NAUK (DAN) in 1981-82, Yu. Babayev and Yu. Baurov in the preprints of the Institute of Nuclear research of the USSR Academy of Sciences in 1984-85) showed that the masses of all elementary particles are proportional to the modulus of the cosmological vector potential $A_g$—the new predicted vector fundamental constant. According to theory, it is impossible to increase $A_g$. But if electric power is applied to a solenoid cylinder with a conductor wound around it, creating the vector potential of a magnetic field directed against the vector of the cosmological potential, then the resultant potential is decreased. A buoyancy force will act on any body in that region of space in such a case. It was predicted in the works of the author and has been scientifically substantiated (see the anthology of TsNIIMASh [Central Scientific Research Institute of Machinery Manufacturing and Metalworking], "The Physics of Plasma and Some Questions of General Physics") in 1990. Thus was demonstrated the physical essence of $A_g$, which is one of the fundamental objects, one-dimensional discrete "magnetic" fluxes, minimization of the potential energy of the interaction of which leads to the formation of the whole three-dimensional world observable by us, the world of elementary particles and their wave properties.

A host of astrophysical phenomena based on the interaction of those fluxes are explained with the aid of the model: the derivation of galactic and intergalactic magnetic fields, residual radiation, the 22-year cycle of the sun and the displacement of the axis of the earth's rotation, among others. The physics values obtained via calculations correspond to known ones from astronomy and astrophysics.

Practice, as is well known, is the criterion of truth, and experiments performed in conjunction with staff members Ye. Klimenko and S. Novikov from the Institute of Atomic Energy imeni I.V. Kurchatov (IAE) in 1987-90 on experimental installations at the IAE and the Institute of General Physics of the USSR Academy of Sciences to confirm the existence of the predicted force were thus of particular importance. The results of the experiment confirmed its existence. They were published in the DAN in December of 1990 by recommendation of Academician A. Prokhorov, who had supported this non-traditional scientific research.

The magnitude of the force acting on a load with a mass of 30 grams in the region of diminished $A_g$ was 0.1 grams. It is understandably determined by the capabilities of the equipment used. The results of this work elicited a great deal of interest at a session of the Nuclear Physics Department of the USSR Academy of Sciences that was held in Moscow in November of last year. Several groups of experimental physicists are conducting research today to clarify the properties of this force.

Recent experiments are giving rise to confidence that a new principle of motion can be realized with its help. A body being ejected from the region of a physical vacuum in which a decrease in the cosmological vector potential is occurring, while tightly fastened to the solenoid itself, pulls it along. With an asymmetrical positioning of the matter in a region with diminished cosmological potential, in other words, the directional movement of the source of the magnetic field can be organized.

Just where does the energy come from in this case? This analogy may be drawn: a machine is digging a hole in front of itself, moving ever deeper under the effects of the force of the earth's attraction. Work is being expended only to dig up the dirt. The movement occurs herein through the energy of the gravitational field. In the realization of the new principle of motion, a magnet creates only some region of space from which any matter is ejected, as a result of which the magnetic system itself moves through the energy of a physical vacuum.

One must talk about superconductivity in particular. It is clear to many today that this state of a conductor leads to an absence of losses of energy when an electrical current passes through it. The phenomenon was first observed in

metals at the temperature of liquid helium, *i.e.* about absolute zero. The cooling machinery has to work very hard, however, in order to obtain those conditions. Scientists in various countries around the world have not given up, however. The manufacture of materials possessing this property under more easily created conditions has promised a revolution in engineering in a number of directions. Conductors have now been manufactured from substances in which this new quality is achieved at the temperature of liquid nitrogen, a widespread and cheap gas. The fact that those modes are achieved in space without the expenditure of energy, and only with the aid of passive systems of thermal regulation, is exceptionally significant here.

What does this provide? An opportunity to create systems of magnet-solenoids operating under conditions of superconductivity today. And energy need not be expended therein for the cooling of the conductor. The resultant heat thus need not be removed as a consequence. The latter is extremely important, since removing it into the surrounding space in outer space could be done only with the aid of radiation, which would require enormous heat sinks.

The new principle of motion, as we see, is ecologically clean, because any emissions to the outside are lacking. The service life of engines is enormous and is defined by the time period for the operation of the superconducting solenoid system. Their thrust is not yet very great, and they are thus suitable only for interorbital and interplanetary flights. If the existence of the new law of nature is confirmed, this apparatus could be designed using existing technology—that is, in the not-too-distant future! The creation of systems that develop a force sufficient for a launch from earth is fundamentally possible with the development of high-temperature superconductivity. An additional advantage would appear in that case—the launch vehicle would not require several stages in order to reach escape velocity. The problem that exists today of the fall of spent stages to earth and the necessity of setting aside large areas of territory for the flight path, as well as picking up the wreckage, would disappear. The expenditure of energy under conditions of superconductivity is necessary only for the creation of the necessary potential for the solenoid at the launch, and it need not be expended in motion. That is, there is no need for stores of energy in the form of fuel in the launch vehicle and, as a consequence, no need for multistage launch vehicles.

All of this is possible if the main thing happens—confirmation of the results of the experiments by other scientists. Much work and many difficulties, failures and, possibly, victories, still lie ahead.



## Attempts to Control Descent of Salyut-7/Kosmos-1686 Described

*92UM0063K Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 5, May 91 (signed to press 10 Jun 91) pp 44-45*

[Article by Lieutenant Colonel V. Maksimovskiy under the rubric "Problems of Space Science": "Not Holiday Fireworks At All"]

[Text] *The last to work in the Salyut-7/Kosmos-1686 complex were cosmonauts L. Kizim and V. Solovyev. When they left the complex on 25 Jun 86, it was in circular orbit at an altitude of about 340 km [kilometers] and could have remained an artificial earth satellite for at least another 200 days without any corrections in its orbit. The Salyut-7, even though it had served longer than its stipulated design life but remained operable, had already been replaced. The launch of the new Mir space station—true, not yet fully equipped—took place on 20 Feb 86, timed to coincide with the opening of the 27th CPSU Congress. But there was not enough manpower for their simultaneous support. So the Salyut became a burden...*

Strictly speaking, a commonplace event. There remained enough fuel aboard the Salyut-7, as envisaged in the operational documentation, so as to end the existence of the complex, bringing it down in a guided descent to a designated region of the Pacific Ocean. Specialists in the realm of space working at the USSR Ministry of Defense, recalling the American Skylab orbital space station that burned up over Australia in 1979, recommended that in their conclusion. There was also sense in the proposal of the Energiya NPO [Scientific Production Association] to continue the unique testing, under natural conditions, of the station systems and the materials from which it was manufactured. The TsNIIMASh [Central Scientific Research Institute of Machinery Manufacture and Metalworking] of the Ministry of General Machine Building had determined that if the fuel on board were to be used only to increase the altitude of the orbit, the complex would pose no danger to people on earth for another eight to twenty years.

It was proposed to bring its structural elements to earth using the Buran reusable space shuttle. But just how? This question had evidently not been seriously considered. Why do I think so? First of all, the station was by that time in all likelihood uncontrollable, which would have made docking with it problematical. In the event they were successful, the spacewalking crew members of the Buran were to release the mechanical clamps uniting the Salyut-7 with the Kosmos-1686 and remove the panels from the solar batteries, which have an area of about 100 $m^2$. They naturally would still have had to accommodate the Salyut in the cargo bay of the Buran. But how could the winged craft land with a cargo of 23 tons if it is designed for 20?

Well then, 20 years is a long time, and space technology develops rapidly. They apparently were also taking that into account when making their decision.

There was enough fuel left on 23 Aug 86 to move the station into an orbit with an apogee of 492 km and a perigee of 474. The time of existence of the complex (until entry into the dense layers of the atmosphere), according to the calculations of military specialists, was just 5.2 to 9.6 years with the conventional activity of the sun and its expected increase taken into account. The density of the atmosphere actually increased considerably more than was forecast...

It became clear what would happen if active measures were not taken. It was necessary to launch the Soyuz spacecraft to refuel the tanks of the Salyut-7 and perform a guided descent of the whole complex nonetheless. Greater additional spending would of course have been required therein for the "superfluous" flight. And many felt it really was superfluous, since they were taking into account that manual docking with a station that was uncontrollable due to the exhaustion of fuel could also fail to have positive results. And an insufficient quantity of fuel would have been delivered on one run even in the event of success.

It must be said that the professionals, as opposed to those who are not connected with space, had a wholly concrete attitude toward the Salyut situation. It was formulated on the basis of precise sciences that envisage the presence of a certain degree of uncertainty—that is, the risk of not obtaining the result on which they were counting. There was logic in their reasoning here as well. There really were just a few dozen elements that could reach the earth's surface, and the dimensions of almost all of them were not great. And the surface of the planet is so large! It was considered possible to disregard the likelihood of its falling among people. This is the usual, widely employed technocratic approach. Therefore, in the old manner, not only did no one intend to organize the guided descent of the complex, but even to notify the public of the coming event.

There was a report in the mass media, however, and there was practically a panic among the population. A few people meanwhile found out about this at first, for that matter, from foreign sources, because they are also tracking our space program there, monitoring the state of objects and, as they say, truth will out. A. Tarasov, a special correspondent of PRAVDA later clarifying the possible consequences with the chief of Glavkosmos, A. Dunayev, at a press conference with our and Japanese journalists, advised everyone to provide themselves with helmets.

Unfortunately no analytical material by a specialist was published during the period of appearance of tendentious articles by some journalists who discerned evil intent in the actions of the people occupied with outer space. Space hardware, as testified to by the statistics, is the most reliable of the machinery and devices created by man; it is simply in the public eye, and trouble is perceived too emotionally.

What are the reasons that no steps were undertaken aside from the usual monitoring of the orbit? Because several artificial space objects (spent satellites, the last stages of launch vehicles) enter the dense layers of the atmosphere every week. Every week! And no one in the West or here makes any announcements. That is the stereotypical thinking that has taken shape. There have been no victims thus far, after all. I am sure that the majority of the population of the USSR forgot to even think about the Salyut-7—they have other concerns. Just how much trouble are a few dozen fragments compared to, say, the tens of thousands who have perished in traffic accidents?

But even though the discussions were mostly about the Salyut-7, it was not a matter of that alone. It must be acknowledged that the falling complex was not an ordinary object. And all due to the "anonymous" Kosmos-1686. This was at one time a promising heavy transport supply craft with a mass of about 20 tons created at the Salyut KB [Design Bureau] to service the Salyut stations they had developed. These were manufactured but not used; the Energiya NPO found a method of proving the expediency of using only their own Progress and Soyuz craft, even though their capabilities for freight delivery were roughly three times less. Seemingly an example of a non-systematic and parochial approach. Both the one and the other probably should have been used. Large specialized modules, after all, are operating as part of the Mir complex today.

One of the craft lying in the shop was refined when they needed a modernized one. The returnable craft, in order to reduce expenses, was used as a pressurized housing for accommodating dedicated equipment, as the result of which it could not deliver freight to earth but had not lost its ability to avoid burning up when entering the dense layers of the atmosphere. It was namely this heat-shielded compartment of about three tons that was the largest element that would not burn up.

The process of the fall of the complex to earth had become irreversible by the summer of last year. Specialists felt that it was already too late to take steps to organize a guided descent. It was now necessary to do everything possible to see that the remnants of the structures fell into the ocean or into a sparsely populated area, and at least to notify the population of the supposed danger zone. But what would the danger be? And where?

A guided descent, when there had been enough fuel on board, had been tried more than once already. The braking engine is turned on at a set time, and the fragments of the satellite that have not burned up fall into a certain region allocated to the Soviet Union in the ocean and closed to navigation. Its dimensions are large, since the trajectory of the fall is sloping and the destruction of the structure when entering the dense layers of the atmosphere occurs according to random law, with each detached element having its own aerodynamics. The zone could be decreased, but more fuel would have to be expended for braking. And it is namely the reserves of

fuel that determine the time of existence of many types of apparatus and the amount of tasks they can perform. It was impossible to predict precisely where the remnants of the Salyut-7/Kosmos-1686 complex would fall.

A special commission was created to coordinate monitoring of the end of existence of the orbital facility. It proved to be possible to ensure the interaction of the operations groups of all of the military and civilian organizations and agencies involved in this without formalism and red tape. They received continuous telemetric information from the Salyut and monitored the parameters of the orbit, forecasting the time and area of the fall. They assessed the technical state of the station and the possibility of purposeful intervention in the course of the flight. The necessary contact and exchange of information with the United States and other countries was also ensured.

The precision of the time forecast for the fall was roughly +15 percent of the time period over which it was issued. Matters were aggravated by the fact that our ship for the command and measurement complex was located in the Caribbean Sea and could not issue information in the final orbits. That is why the estimate of the time and place for the station to fall was made on its last pass over the territory of the USSR: at 6:47 at 34.9° south latitude and 63.8° west longitude. These were, naturally, the coordinates of the center of the ellipse for the scattering of the individual elements, which could be as large as 8,000 x 2,000 km. The actual time of the remnants reaching the earth was not able to be established owing to the lack of information.

Attempts were made to affect the location of the fall area. The Kosmos-1686 was not controllable, but the fuel tanks of the Salyut still had as much as approximately 70 kilograms of fuel. The specialists adjusted the complex along its direction of motion by using that fuel, and preserved its position while the control engines were still operating. There was enough fuel left for less than two orbits, but the reliability and precision of the forecast were increased owing to the more stable position of the object. The remnants of the complex, forming a salute in the night sky, fell as assumed onto South America, starting on the territory of Chile. There were fortunately no victims or damage.

There were many opinions on the score of what happened. I myself feel that we would have gained more by using a specially refined and equipped Soyuz to deliver fuel to provide for the guided descent of the complex—still "alive" nine years after launch! It was also intolerable to neglect the timely informing of the population of the danger, even if seemingly insignificant on a global scale. It could prove to be very serious to each person, the more so as exaggerated by the press, and that had to be taken into account. Would that they trusted the authorities more and were less dissatisfied with space science.

The problem of space trash is becoming more acute for all nations, and not only for those who launch various objects into near-earth orbits. And it will have to be solved sooner or later. Right now would be better. Let the lesson of Salyut not be in vain.



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